Listing of Claims

Claim 1 (previously amended): A method of imaging of electrical activities in a system comprising the steps of:

5   (a) collecting signals over a part of a surface of the system <u>or over a part of a surface out of the system</u> using a plurality of sensors and a data acquisition unit,

       (b) determining positions of the sensors,

       (c) determining geometry information of the system,

       (d) constructing an electrical source model of the system,

10   (e) estimating electrical source distribution and excitation sequence within the three dimension space of the system, by comparing and minimizing the difference between the collected signals and source model generated signals over the same sensor positions and over a certain time epoch, and

       (f) displaying the estimated electrical source distribution and excitation sequence

15   within the three dimension space of the system.

Claim 2 (original): The method of claim 1 wherein said steps (a) to (f) are repeated for sequential time epochs.

Claim 3 (original): The method of claims 1 wherein the system is a biological system.

Claim 4 (original): The method of claim 1 wherein the electrical activities originate in the

20   heart.

Claim 5 (original): The method of claim 1 wherein the electrical activities originate in the brain.

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Claim 6 (original): The method of claim 4 wherein the electrical source model comprises a three dimension distribution of current dipoles or monopoles or electric potentials.

Claim 7 (original): The method of claim 4 wherein the electrical source distributions in the three dimension of the heart are estimated by using weighted minimum norm strategies.

5   Claim 8 (original): The method of claim 4 wherein the electrical source distributions in the three dimension of the heart are estimated by means of weighted minimum norm strategies, and further enhanced by recursive weighting algorithm, in which the weighting matrix W_k is updated by taking the product of W_{k-1} with the diagonal current matrix from the preceding step:

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$$W_k = W_{k-1} \cdot diag(X_1^{k-1} X_2^{k-1} \cdots X_n^{k-1})$$

where each diagonal element of W corresponds to one element of the source.

Claim 9 (previously amended): The method of claim 3 wherein the electrical source model is constructed in such a way that *a priori* knowledge on the properties of physiological excitation processes are incorporated, including cellular action potentials, excitation rules that

15   determine when and whether an excitable cell is to be activated as responding to the inputs from the adjacent excitable cells, models of the excitable membrane as described by differential equations, and inhomogeneity of a biological system.

Claim 10 (original): The method of claim 4 wherein the electrical source model is constructed in such a way that *a priori* knowledge on the properties of cardiac physiological and

20   pathological excitation and repolarization processes are incorporated, including cellular action potentials, excitation rules, and inhomogeneity properties of myocardium.

Claim 11 (previously amended): The method of claim 5 wherein the electrical source model is constructed in such a way that *a priori* knowledge on the properties of brain physiological and pathological excitation processes are incorporated, including <u>properties of neuronal</u> cellular action potentials, excitation rules <u>of the neural electrical activity</u>, and inhomogeneity

5   properties of <u>the</u> brain <u>tissue</u>.

Claim 12 (original): The method of claim 1 further including a step of determining the initial values of the parameters for the electrical source model, using artificial neural networks.

Claim 13 (previously amended): An apparatus for imaging of electrical activities in a <u>three dimensional</u> biological system, comprising a plurality of sensors for detecting signals over a

10   part of a surface of the biological system <u>or over a part of a surface out of the biological system</u>, means for collecting the detected signals, means for determining positions of the sensors, means for determining geometry information of the system, means for constructing an electrical source model of the system, means for estimating electrical source distribution and excitation sequence within the system, by comparing and minimizing the difference between

15   the detected signals and source model generated signals over the same sensor positions over a certain time epoch, and means for displaying the estimated electrical source distribution and excitation sequence within the three dimension space of the system.

Claim 14 (original): The apparatus of claim 13 further including means for imaging of the electrical activities for sequential time epochs.

20   Claim 15 (original): The apparatus of claim 13 wherein the means for collecting the signals include an array of bioelectric electrodes.

Claim 16 (original): The apparatus of claim 13 wherein the plurality of sensors include an array of magnetic sensors.

Claim 17 (original): The apparatus of claim 13 wherein the plurality of sensors includes an array of magnetic sensors and an array of electrodes.

Claim 18 (withdrawn): The apparatus of claim 13 wherein it is used together with a catheter, guiding catheter ablation of cardiac arrhythmia.

5   Claim 19 (currently amended): A method of imaging of electrical activities in a heart within a body comprising the steps of:

      (a) collecting signals over a part of a surface of the body, <u>a part of the surface of the heart within the body</u>, or a part of a surface out of the body, using a plurality of sensors and a data acquisition unit,

10   (b) determining positions of the sensors,

      (c) determining geometry information of the <u>heart within the</u> body <u>and of the torso,</u>

      (d) constructing an electrical source model of the heart, which comprises a three dimension distribution of current dipoles or monopoles or electric potentials, or a computer heart model incorporating physiological *a priori* information that

15   simulates the physiological and pathophysiological processes of the heart;

      (e) estimating activation patterns of the electrical activity within the three dimension space of the heart, by comparing and minimizing the difference between the collected signals and source model generated signals over the same sensor positions and over a certain time epoch, and

20   (f) displaying the estimated activation patterns within the three dimension <u>space </u>of the heart.

Claim 20 (currently amended): An apparatus for imaging of electrical activities of a heart within a body, comprising a plurality of sensors for detecting signals over a part of a surface

of the body, a part of the surface of the heart within the body, or a part of a surface out of the body, means for collecting the detected signals, means for determining positions of the sensors, means for determining geometry information of the heart within the body and of the torso, means for constructing an electrical source model of the heart, which comprises a three

5 dimension distribution of current dipoles or monopoles or electric potentials, or a computer heart model incorporating physiological a priori information that simulates the physiological and pathophysiological processes of the heart, means for estimating activation patterns within the three dimension volume of the *heart,* by comparing and minimizing the difference between the detected signals and source model generated signals over the same sensor

10 positions over a certain time epoch, and means for displaying the estimated activation patterns within the three dimension volume of the heart.

Claim 21 (withdrawn): A method of imaging of electrical activities in a heart within a body comprising the steps of:

(a) collecting signals over a part of a surface of the body or over a part of a surface out

15 of the body using a plurality of sensors and a data acquisition unit,

(g) determining positions of the sensors,

(h) determining geometry information of the body,

(i) constructi ng an electrical source model of the heart, which comprises a three

dimension distribution of current dipoles or monopoles or electric potentials, or a

20 computer heart model incorporating physiological a priori information that

simulates the physiological and pathophysiological processes of the heart;

(j) estimating electrical source distributions within the three dimension volume of the

heart, by comparing and minimizing the difference between the collected signals

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and source model generated signals over the same sensor positions and over a certain time epoch, and

(k) displaying the estimated electrical source distributions within the three dimension space of the heart.

5   Claim 22 (withdrawn): An apparatus for imaging of electrical activities in a heart within a body, comprising a plurality of sensors for detecting signals over a part of a surface of the body or over a part of a surface out of the body, means for collecting the detected signals, means for determining positions of the sensors, means for determining geometry information of the body, means for constructing an electrical source model of the heart, means for

10   estimating electrical source distributions within the three dimension volume of the heart, by comparing and minimizing the difference between the detected signals and source model generated signals over the same sensor positions over a certain time epoch, and means for displaying the estimated electrical source distributions within the three dimension space of the heart.

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